Back Testing User Guide

CMC Markets

INTRODUCTION

The function of backtesting is to test a trading strategy on historical data to see if it could work for future trades, to evaluate its profitability before risking any money.

This document contains the basics of creating a backtest. All backtests are done in a similar way to this document.

There are two ways to create a backtest using the prorealtime charting within Marketmarker, either by using the assisted creation or by programming.

Advantages

- Saving time and money on strategies that don't work
- Optimizing strategies
- Creating winning strategies will make money

Disadvantages

- Previous trends may not be a representation of the future trends particularly when markets turn sharply e.g. 'dotcom' boom in 2000
- Marketmaker does not allow program trading
- Capital management does not consider margin trading
- Chart data is only bid based so it doesn't take into account costs of spread, although commission can be included to represent this
- Costs of rollovers for cash or spot instruments and the cost of carry model for futures is also not represented.

WARNING

The strategies provided in this document are only given to help you understand the use of advanced technical analysis and not suggesting that you try any of these strategies for yourself as they may or may not be profitable.

You may need to modify or optimize these strategies in addition to adjusting the capital management conditions to suit your criteria.

ASSISTED CREATION

This section covers creating a backtest using the assisted creation, which helps us create a backtest using wizards.

Example

Lets create a RSI (relative strength index) indicator on the UK100 cash chart.

- Right click UK100 cash in the tree or a single/group price window to display the chart and change the time frame to 1 year/daily on the toolbar
- Then click add indicator, under the indicator tab a single click left on RSI will give us a description on the right about the indicator and how its calculated but you need to double click on RSI to create the indicator
- Click close on the properties window that appears we will use the standard defaults

You will now have a chart with an indicator as seen in figure 1 below.

Figure 1: UK100 chart with an RSI indicator

The Three Stages to a Backtest

1. Order Definition

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest

Here you are presented with two options either to create a backtest using the assisted creation or by programming.

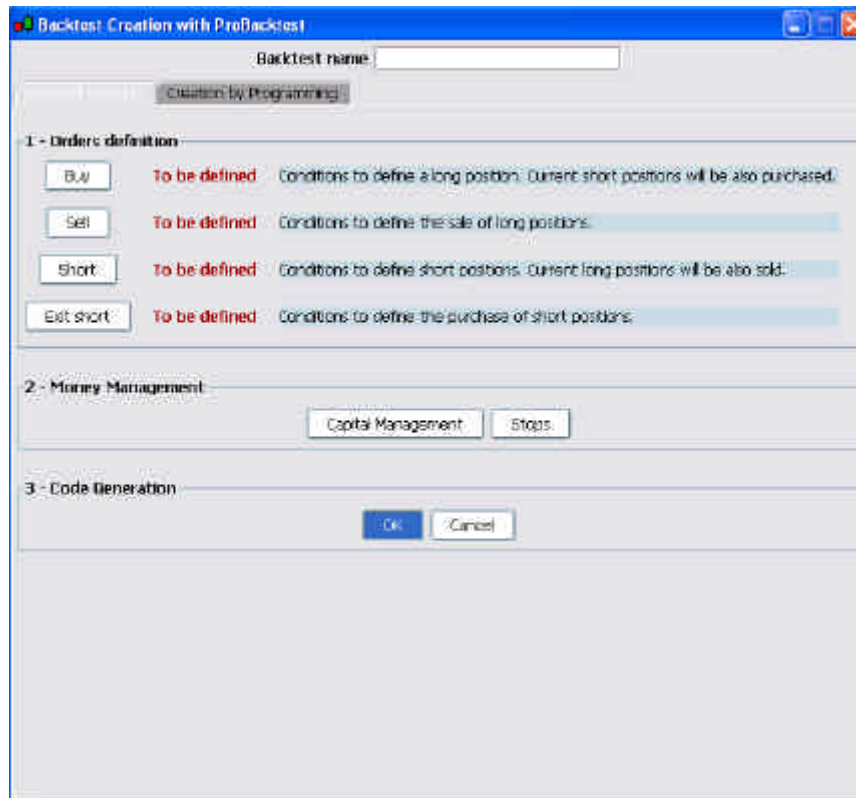- Click on the assisted creation tab as seen below in figure 2

Figure 2: options to create a backtest

For simplicity in this example we will use the assisted creation. We will create a long strategy to buy when the RSI is <= (below or equal to) 35 and sell the position once RSI is >= (above or equal to) 65.

- To enter the condition to go long click on buy, the assisted creation will prompt you to click on the chart as seen in figure 3
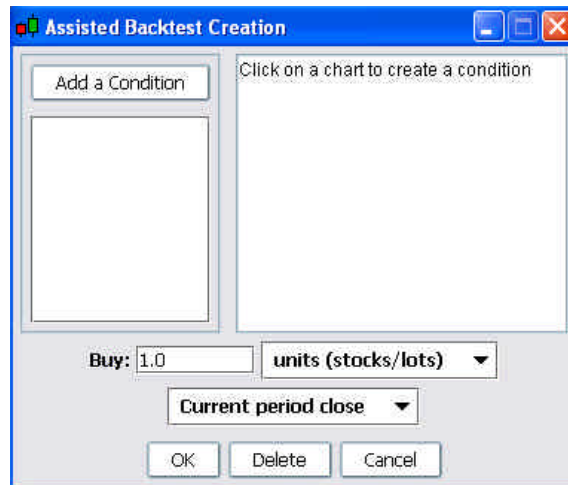
Figure 3: defining an order in assisted creation

- Click on the RSI indicator on the chart as we are defining conditions related to this
- Then define the conditions so that we buy when RSI is <= to a value of 35 with a quantity of 100 000 then click OK, as shown in figure 4 below
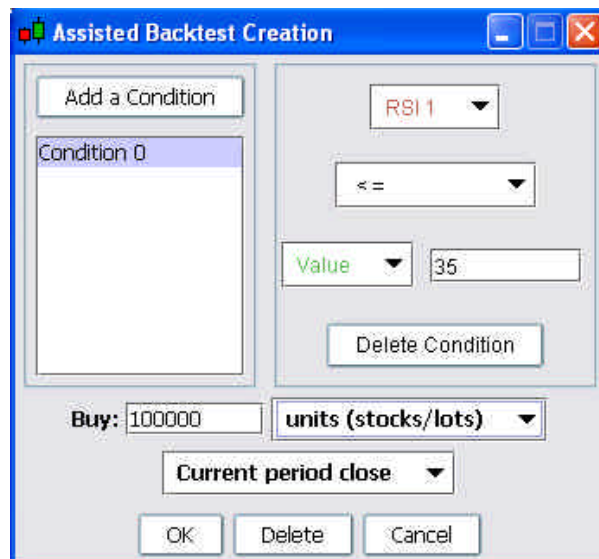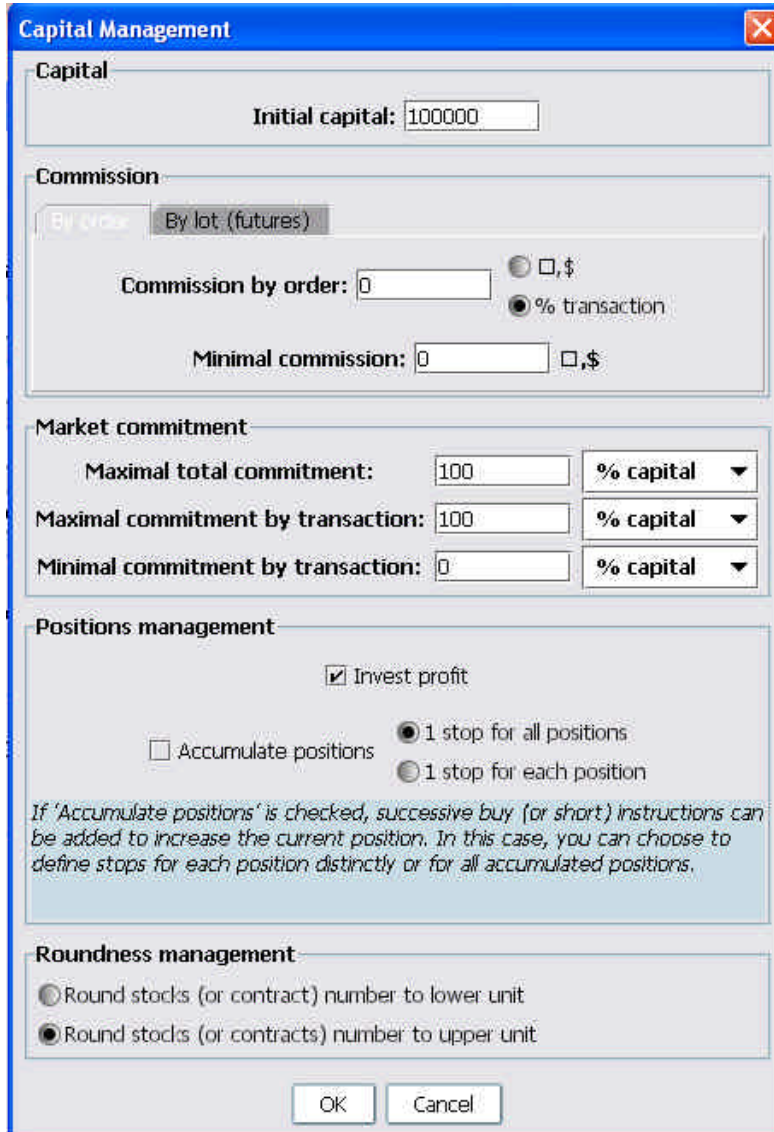

Figure 4: a defined order condition to enter a long position

- Click on the sell and define the RSI to be >= value of 65 and OK the box

Tip: if you make a mistake just click on the order definition again shown in figure 2.

2. Money Management

- Click on the capital management button (as seen in section 2 of figure 2) and the screen shown in figure 5 will open. Our initial capital of 100 000 should already be defined. In this case set the commission by order and the minimum commission to 0 then click OK to close the window. For this example leave everything else the same as we want to invest all our money on a compound basis
- We wont define any stops for this example

Figure 5: configuring capital management

3. Code Generation

- Press ok to create the program. The program is created as seen in figure 6.

This line is a note to yourself, you can write anything after REM and it will be ignored

Defines our indicator RSI based on the closing price of 14days

You can name the indicator anything with the condition <=35

End the program

If condition is met then buy the quantity on the close of the bar at market price

```
REM Buy

Indicator1 = RSI[14](close)
c1 = (indicator1 <= 35.0)

IF c1 THEN
     BUY 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF

REM Sell

Indicator2 = RSI[14](close)
c2 = (indicator2 >= 65.0)

IF c2 THEN
     SELL  AT MARKET THISBARONCLOSE
ENDIF
```

Figure 6: the assisted creation generates our code

- Enter a name for this backtest, its best to tick the box to keep the window open at the bottom, before validating the program

Tip: you always need to enter a name for the backtest else it will produce an error stating to enter a name.

A detailed reported will be produced with 3 tabs as displayed below in figure 7. The below default statistics tab shows the overall strategy produced 2 trades of which both were profitable.

Detailed Report: RSI example

	All Trades	Long Trades	Short Trades
Total Net Profit	9131.00	9131.00	0.00
Gross Profit	9131.00	9131.00	0.00
Gross Loss	0.00	0.00	0.00
Profit Factor	n/a	n/a	n/a
Total number of Trades	2	2	0
Percent Profitable	100.00%	100.00%	n/a
Winning Trades	2	2	0
Losing Trades	0	0	0
Even Trades	0	0	0
Avg Trade Net Profit	4565.50	4565.50	n/a
Avg Winning Trade	4565.50	4565.50	n/a
Avg Losing Trade	n/a	n/a	n/a
Std Deviation of Trade Profit	165.50	165.50	n/a
Largest Winning Trade	4731.00	4731.00	0.00
Largest Losing Trade	0.00	0.00	0.00
Avg Bars in Trades	33.50	33.50	n/a
Avg Bars Between Trades	262.00	262.00	n/a
Avg Bars in Winning Trades	33.50	33.50	n/a
Avg Bars in Losing Trades	n/a	n/a	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	20.36%	20.36%	20.36%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	0	0	0
Max Consecutive Losing Trades	0	0	0
Max draw down	3135.00	3135.00	0.00
Max equity run up	10491.00	10491.00	0.00
Return on initial capital	9.13%	9.13%	0.00%

Modify Backtest   Close

Figure 7: detailed report of our backtest showing the overall statistics

Note: The return on capital will not be displayed correctly due to margin trading not being taken into account. However the net profit will continue to change real time if positions are open.

The orders list tab displayed in figure 8 shows our 4 trades being entered with our total equity changing as we enter and exit trades.

Although we are investing 100 000 and using 100% of capital on our trades the system only buys 20 as 100 000/4826 = 20 which is equal to 20usd/pt (as the system is in US Dollars). The current value just refers to the quantity times the price, e.g. 4826 x 20 = 96520 which is the contract value.

Alternatively we can view this 9+% return as 900+% because we only have to use 1% as margin on indices at CMC Markets, based upon investing all our capital.

Figure 8: orders placed in our backtest

The trades list tab in figure 9 below shows our 2 trades and their direction.

Figure 9: the 2 trades and their direction

The chart below in figure 10 shows our backtest results, which can be saved using the paintbrush icon.

This part of the chart shows our total equity changing with time when holding the position, flat lines indicating that no positions are being held
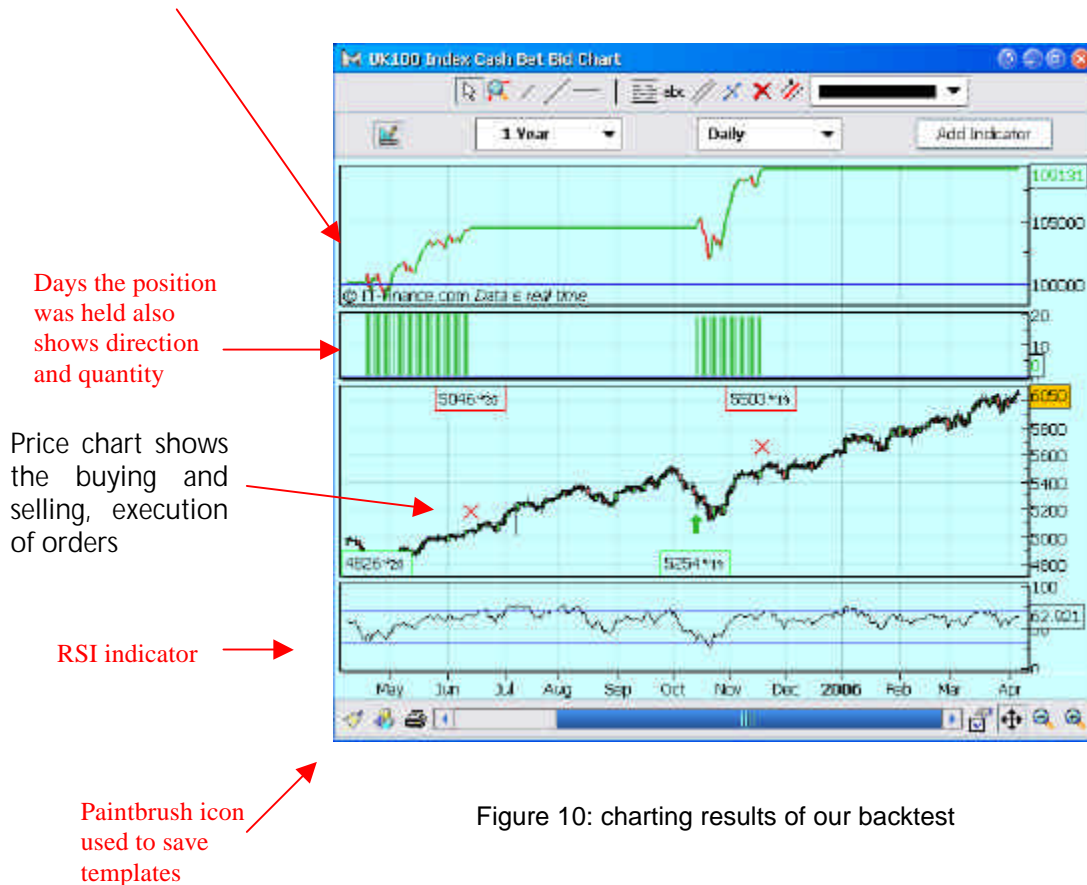

Days the position was held also shows direction and quantity

Price chart shows the buying and selling, execution of orders

RSI indicator

Paintbrush icon used to save templates

Figure 10: charting results of our backtest

Note: The values you get for your backtest maybe different unless you use the same start and end dates. This is because the first and last date is used as the standard default. We will see later how this can be changed.

Tip: To read the chart more clearly, you tick the value boxes under the chart options in the options menu in Marketmaker as seen in figure 11. Then whichever chart you look at as in figure 12 the value box is displayed providing more detailed information as the chart is read for you.
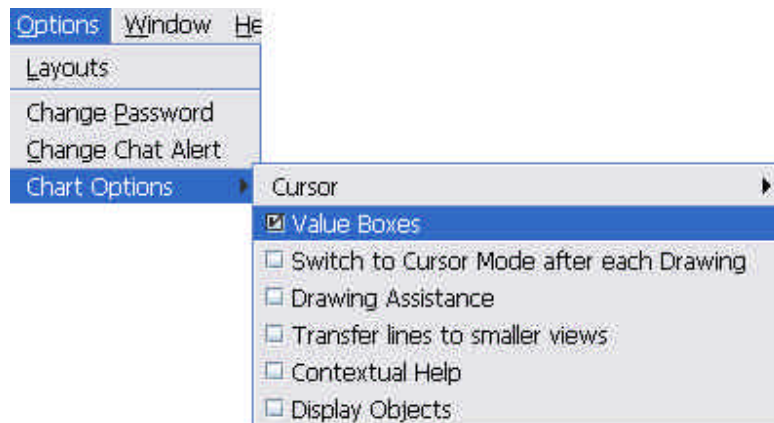
Figure 11: how to enable value boxes in Marketmaker

Figure 12: an example of a value box of USDJPY on 20 Mar 06

Creating a Short Position on a Backtest

Order Definition

You can also enter shorts in the order definition of the assisted creation where you must define the exit of the short to close the position.

Once you have your chart with your indicator:

- Click add indicator then click on the backtest tab, create backtest
- Click on assisted creation tab
- To enter the condition to go short click on short, the assisted creation will prompt you to click on the chart
- Define your shorting criteria and click ok
- Then click on exit short and as above define your criteria from the chart

Advanced – Refining your Backtest

Capital Management

Below is a breakdown of what the capital management window shown in figure 11 represents.
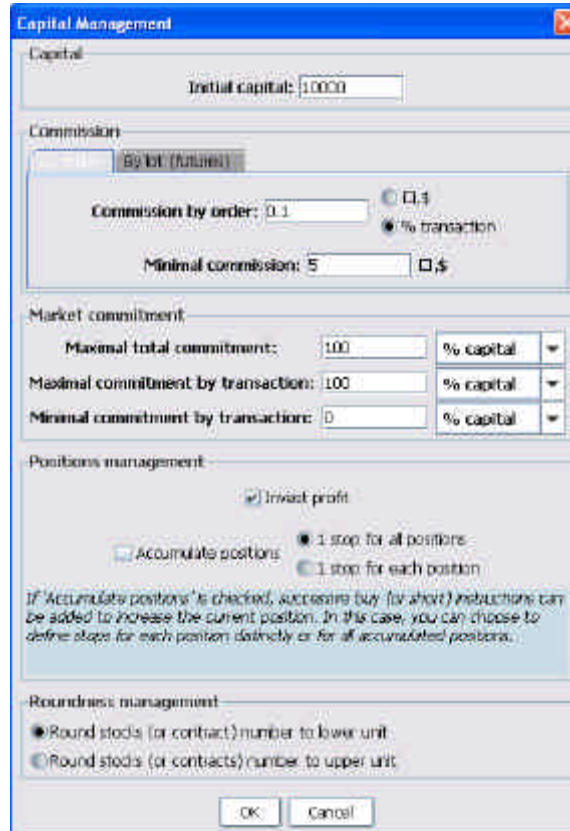
Figure 11: the capital management window

Initial Capital

You can define the initial capital from one of two ways. Either via the capital management under the capital section or when defining order definitions i.e. like in the first example when entering a buy condition or entering a short condition.

As previously stated it does not create margin trading hence for example if you decided to invest 100 000 on GBPUSD at a price of 1.8000 this will give you a position of 55 555. However with an FX account, margin is 1% so you could effectively buy 10 000 000. As another example if you wanted to buy 100 000 worth of BP (UK) stock at 625 that would be 156 (both rounded down) but really at 3% margin you could buy 5333. The initial capital is in USD but here we are only concerned with the quantities. Hence you need to adjust the initial capital to reflect your gearing or calculate the returns yourself by multiplying the factor of leverage.

Commission

This can only be defined by order and not by lot as suggested.

Commission by order can be either set per fixed amount per transaction or by percentage only in dollars. A minimum can also be set. This will take into account both sides of the trade i.e. on opening and closing.

Market Commitment

The amount of money you wish to allocate to any trade can be set either as a percentage of capital or cash or a fixed US dollar cash amount; with a maximum and minimum commitment per transaction.

Positions Management

You can choose to invest any profit that is accumulated by ticking the box 'invest profit'.

By ticking accumulate positions when the criteria for your entrance on long/short position is reached the backtest will effectively add to your position.

The stops on accumulative positions can be the same for the entire position or for each position, simply tick the appropriate box.

Roundness Management

When entering positions you can either round the number or shares up or down, as fractions cannot be bought/sold; again define the criteria with the appropriate box.

Stops

When defining stops using the assisted creation there are four choices as in Figure 12.
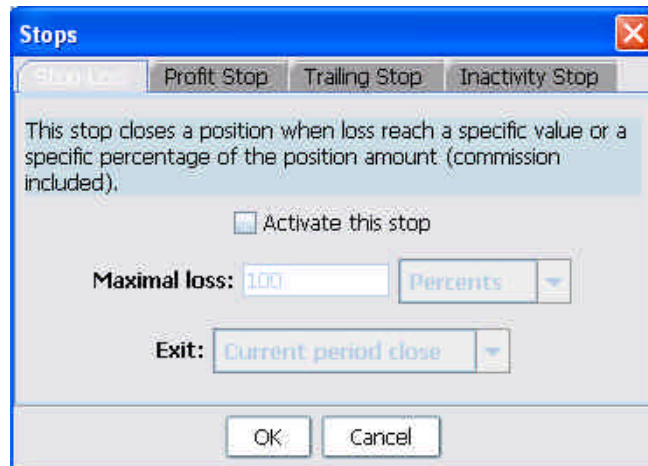
Figure 12: shows the different types of stops that can be used

Stop loss

This stop closes a position when a loss reaches a specific value or a specific percentage of the position amount including commission

- Tick activate this stop and choose the percentage or points for execution including on which bar to activate

Profit Stop

This stop closes a position when a profit reaches a specific value or percentage commission included

- Tick activate this stop and choose the percentage or points for activation along with when

Trailing stop

This stops closes a position when a specific value or percentage of profit was lost compared to the maximum potential profit reached since the beginning of the position (commission included).

- Tick activate this stop and choose the percentage or points for profit decrease along with when

Inactivity Stop

This stop closes a position if for a given period, price did not move in a profitable way of a given percentage.

- Tick activate this stop and choose the percentage or points for activation along with when and include the period

Test Yourself

Try to create a US30 chart displayed for one year based on a daily time frame, with an MACD indicator not the simplified MACD.

Conditions for long positions

For our backtest we want to create only long positions, so that we buy when MACD 1 (blue line) crosses under signal 1 (red line) and sell when MACD 1 crosses over signal 1.

Conditions for capital management

Enter the initial capital as 100 000 where we reinvest all the profits with no commissions on our trades; we don't want any stops either.

(Turn the page if you struggle)

Lets create a MACD indicator on the US30 cash chart.

> ➢ Right click US30 cash in the tree or a single/group price window to display the chart and change the time frame to 1 year/daily on the toolbar

> ➢ Then click add indicator and double click on MACD on the left under the indicator tab

> ➢ Click close on the properties window that appears we will use the standard defaults

You will now have a chart with an indicator like figure 13 seen below.
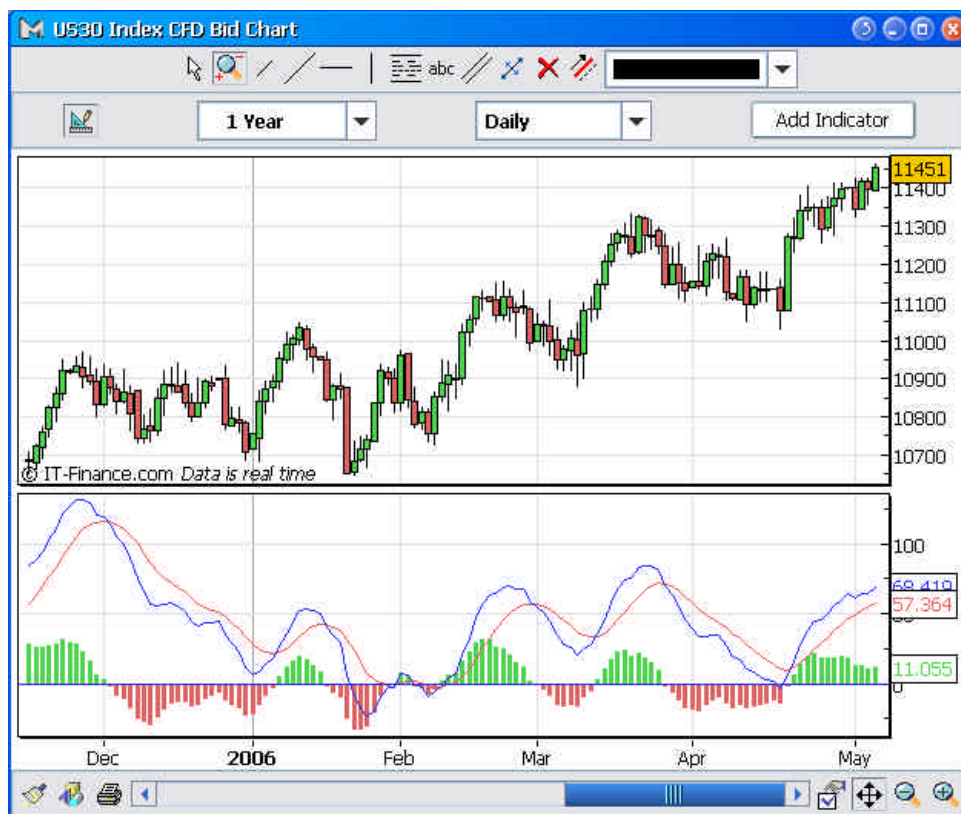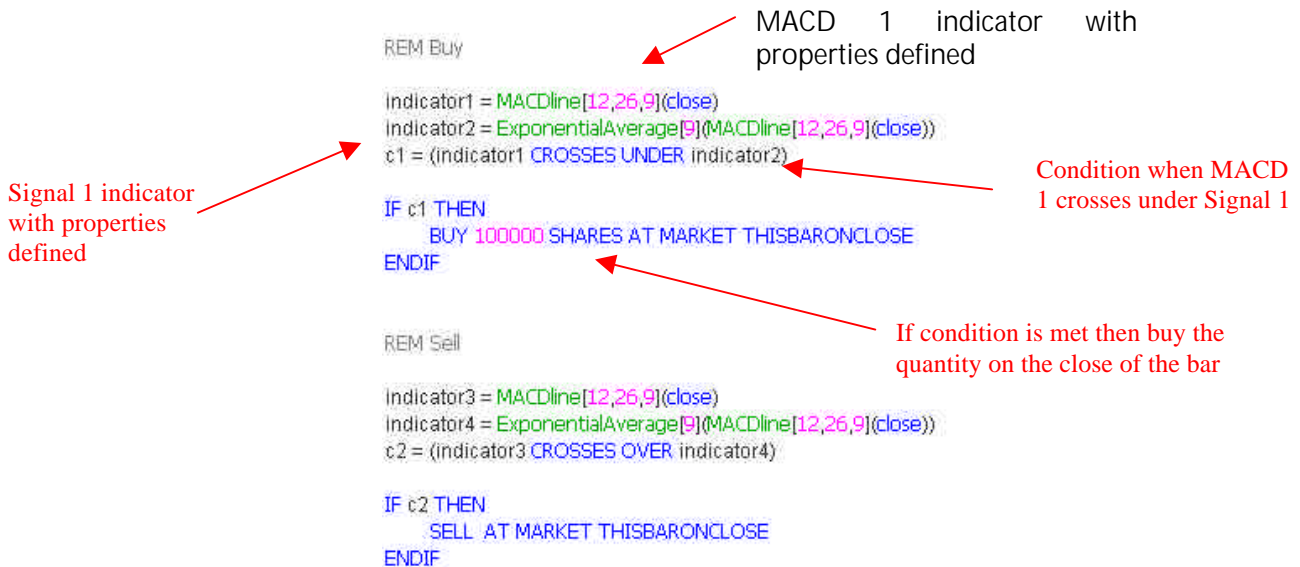
Figure 13: US30 chart with an MACD indicator

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest

- Click on the assisted creation tab

- Click on buy and then MACD on the chart

- Then define the conditions so that we buy when MACD 1 (blue line) crosses under signal 1 (red line) with a quantity of 100 000 then click OK

- Click on the sell for the condition when MACD 1 crosses over signal 1

- Click on the capital management button. Our initial capital of 100 000 should already be defined. In this case set the commission by order and the minimum commission to 0.
- Press ok to create the program

Figure 14 shows the program that is produced.

MACD 1 indicator with properties defined

Signal 1 indicator with properties defined

Condition when MACD 1 crosses under Signal 1

If condition is met then buy the quantity on the close of the bar

```
REM Buy

indicator1 = MACDline[12,26,9](close)
indicator2 = ExponentialAverage[9](MACDline[12,26,9](close))
c1 = (indicator1 CROSSES UNDER indicator2)

IF c1 THEN
    BUY 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF

REM Sell

indicator3 = MACDline[12,26,9](close)
indicator4 = ExponentialAverage[9](MACDline[12,26,9](close))
c2 = (indicator3 CROSSES OVER indicator4)

IF c2 THEN
    SELL AT MARKET THISBARONCLOSE
ENDIF
```

Figure 14: shows the program generated

➢ Enter a name for this backtest and then validate the program

Figures 15-18 display the detailed results and chart produced. In this case it seems that this may have been a good trading strategy with 78% profitable trades, remember percentage return doesn't include gearing.

Detailed Report: MACD-US 30

Orders list   Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	7299.00	7299.00	0.00
Gross Profit	10611.00	10611.00	0.00
Gross Loss	-3312.00	-3312.00	0.00
Profit Factor	3.20	3.20	n/a
Total Number of Trades	14	14	0
Percent Profitable	78.57%	78.57%	n/a
Winning Trades	11	11	0
Losing Trades	3	3	0
Even Trades	0	0	0
Avg Trade Net Profit	521.36	521.36	n/a
Avg Winning Trade	964.64	964.64	n/a
Avg Losing Trade	-1104.00	-1104.00	n/a
Std Deviation of Trade Profit	1065.12	1065.12	n/a
Largest Winning Trade	2061.00	2061.00	0.00
Largest Losing Trade	-2745.00	-2745.00	0.00
Avg Bars in Trades	11.71	11.71	n/a
Avg Bars Beetween Trades	14.92	14.92	n/a
Avg Bars in Winning Trades	10.00	10.00	n/a
Avg Bars in Losing Trades	18.00	18.00	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	45.81%	45.81%	45.81%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	3	3	0
Max Consecutive Losing Trades	2	2	0
Max draw down	-4599.00	-4599.00	0.00
Max equity run up	9837.00	9837.00	0.00
Return on Initial capital	7.30%	7.30%	0.00%

Modify Backtest   Close

Figure 15: detailed statistics report from the backtest

Figure 16: the 28 orders for this backtest

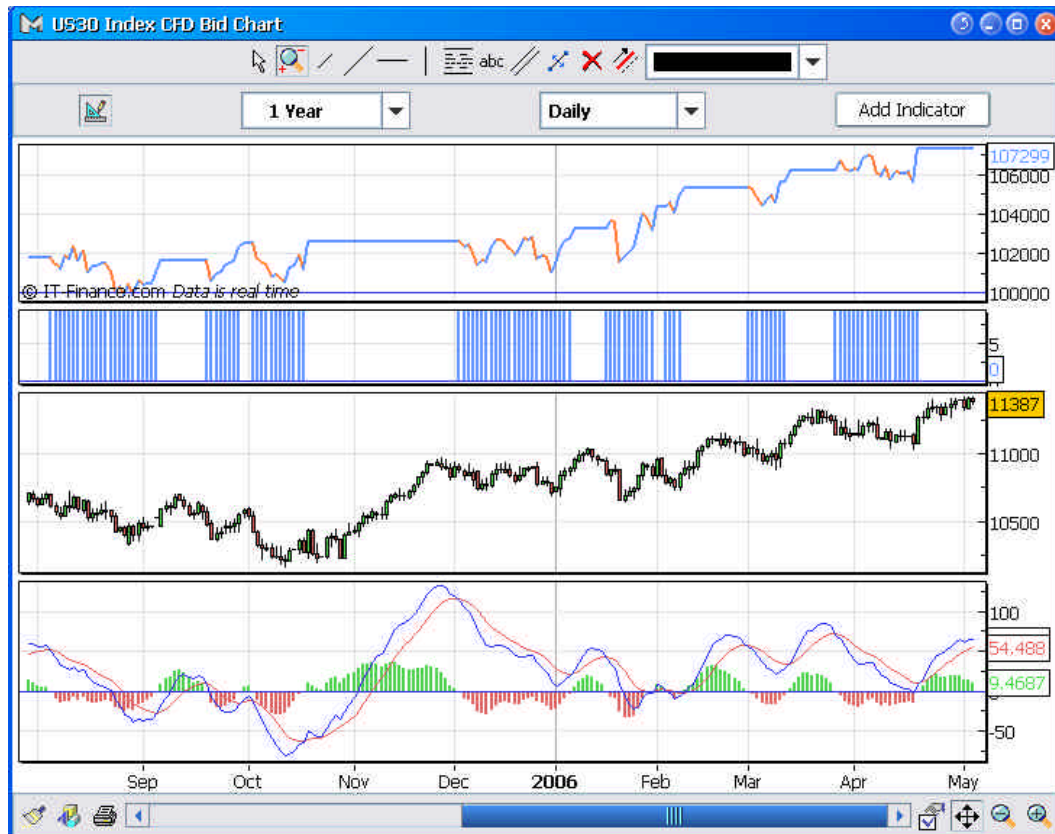Figure 17: the 14 trades created by our backtest showing direction

Figure 18: the graphical representation of our backtest

Optimization

You can optimize your backtest to try and produce greater profits by redefining parameters so that system can calculate what the best parameter will be for optimum results.

It will be easier to understand with an example.

Create a GBPUSD spot chart and add a CMO (chandle momentum indicator) leaving the default properties.

We are looking at the decline taking place between 10 Mar 05 to 30 Nov 05 as seen in figure 19. We will be shorting when CMO is >= 37 and closing our short when CMO is <=-37.
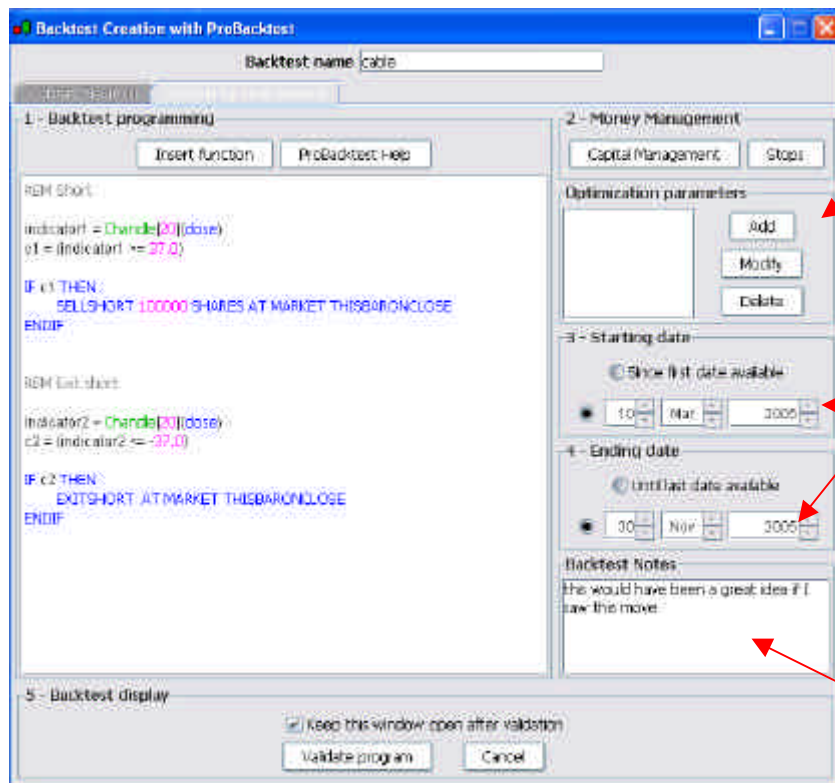
We will then optimize this strategy so that our entrance price is at its optimum, and see what changes if any take place with our return on capital.

Figure 19: GBPUSD chart with a CMO indicator

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest using the assisted creation

- Click on short and then CMO on the chart
- Define the conditions to short 100 000 when Chande 1 is >= to a value of 37
- Click on the exit short for the condition when Chande 1 is =< to a value of –37
- Check that the commission by order and the minimum commission is 0 under capital management and that the initial capital is correct
- Press ok to create the program and enter a name
- Enter the starting and ending date in section 3 and 4 as shown in figure 20
- Tick the box 'keep this window open after validation' and validate the program

Figure 20: program for our backtest with defined properties

Figures 21-24 show the results that are produced

Figure 21: detailed statistics report

Figure 22: orders list for the backtest

Figure 23: the four trades with their direction

Figure 24: GBPUSD chart with backtest results

- If you click on 'modify backtest' on the detailed report, it will take you back to programming of our backtest

Now we will create the optimization, change the sell short figure from 37 to 'number' as seen in figure 25.

Change this from 37 to number so that optimization conditions can be defined for 'number'

```
REM Short

indicator1 = Chandle[20](close)
c1 = (indicator1 >= number)

IF c1 THEN
    SELLSHORT 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF


REM Exit short

indicator2 = Chandle[20](close)
c2 = (indicator2 <= -37.0)

IF c2 THEN
    EXITSHORT  AT MARKET THISBARONCLOSE
ENDIF
```
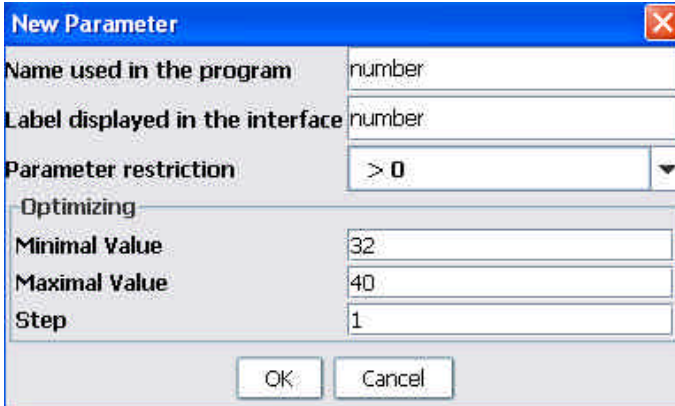
Figure 25: conditions redefined to enter our short

- Under the optimization parameters section shown in figure 20. Click on add and fill in the fields like figure 26, so that we have a range for our entrance trade from 32 to 40 with increments of 1

Figure 26: defining the optimization

- Click ok and then validate the program again. The below results (figures 27-31) are now produced

Detailed Report: cable			
	All Trades	Long Trades	Short Trades
Total Net Profit	8283.92	0.00	8283.92
Gross Profit	8283.92	0.00	8283.92
Gross Loss	0.00	0.00	0.00
Profit Factor	n/a	n/a	n/a
Total Number of Trades	4	0	4
Percent Profitable	75.00%	n/a	75.00%
Winning Trades	3	0	3
Losing Trades	0	0	0
Even Trades	1	0	1
Avg Trade Net Profit	2070.98	n/a	2070.98
Avg Winning Trade	2761.31	n/a	2761.31
Avg Losing Trade	n/a	n/a	n/a
Std Deviation of Trade Profit	1248.15	n/a	1248.15
Largest Winning Trade	3109.89	0.00	3109.89
Largest Losing Trade	0.00	0.00	0.00
Avg Bars in Trades	17.75	n/a	17.75
Avg Bars Beetween Trades	52.33	n/a	52.33
Avg Bars in Winning Trades	23.67	n/a	23.67
Avg Bars in Losing Trades	n/a	n/a	n/a
Avg Bars in Even Trades	0.00	n/a	0.00
Percent of Time in the Market	31.14%	31.14%	31.14%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	0	0	0
Max Consecutive Losing Trades	0	0	0
Max draw down	3387.90	0.00	3387.90
Max equity run up	8346.21	0.00	8346.20
Return on initial capital	8.28%	0.00%	8.28%

Figure 27: optimization statistics shown in the detailed report

Figure 28: optimization orders list

Figure 29: optimization trades list with direction

From the optimisation we still have the same number of trades as four. However our third trade was executed at a better price to short on 11 Aug at 1.8102 rather than 10 Aug at 1.7966, which in turn has increased our profits from a return of 7.5% to 8.28%

The optimisation report in figure 30 shows us our profits at different optimisation parameter points that we defined earlier between 32 to 40 in order of the most profitable condition.

CMC Markets

Net Profits ↑	Return on Capit	Max Draw Dow	Nb Orders	% Winning Tra	Expectation	number
8283.91	+8.28%	3387.90	4	75.00%	n/a	38
7497.21	+7.50%	3413.48	4	75.00%	n/a	36
7497.21	+7.50%	3413.48	4	75.00%	n/a	37
7396.64	+7.40%	3410.31	4	75.00%	n/a	32
7396.64	+7.40%	3410.31	4	75.00%	n/a	33
7396.64	+7.40%	3410.31	4	75.00%	n/a	34
7396.64	+7.40%	3410.31	4	75.00%	n/a	35
5017.98	+5.02%	3285.70	3	66.67%	n/a	39
5017.98	+5.02%	3285.70	3	66.67%	n/a	40

Figure 30: detailed optimization report

Figure 31: chart displaying the optimized backtest

CREATION BY PROGRAMMING

ProRealTime provide some modules and manuals to assist you in creating backtests. You can access this from either www.prorealtime.com/en or by clicking the 'ProBacktestHelp' as seen in figure 20.

This following section uses some of the information provided from prorealtime and simplifies it. Having gone through the assisted creation this section should be easier to understand.

Order Definition

As in the assisted creation we define our conditions for our order.

Long positions

BUY *count* **SHARES** (**AT MARKET** | **AT** *price* **LIMIT** | **AT** *price* **STOP**)
A long position will be opened using this command. If you were already short prior to this, the short will be closed and the position bought would put you long by the *count* of shares stated. If you were already long prior to this execution then this command would depend on conditions stated within capital management.

SELL *count* **SHARES** (**AT MARKET** | **AT** *price* **LIMIT** | **AT** *price* **STOP**)
Long positions will be sold using this command. If the positions are flat or short then nothing will happen. If the backtest is long the *count* shares are sold, if the number is greater than the long position then the position does not go short, if no *count* is used all the position is sold.

Short positions

SELLSHORT *count* **SHARES** (**AT MARKET** | **AT** *price* **LIMIT** | **AT** *price* **STOP**)
This command opens a short position. If the position is already long, then it is reversed to be short by the count. If you were already short prior to this execution then this command would depend on conditions stated within capital management.

EXITSHORT *count* **SHARES** (**AT MARKET** | **AT** *price* **LIMIT** | **AT** *price* **STOP**)

A short position is closed with this command. If the position is flat or long then nothing happens. If the position is short then the *count* shares are bought, if *count* was greater than the short positions, a long position is not opened but the position will be flattened; if no *count* is used all the position is bought.

An example of the use of these commands as market, limit and stop is shown in figure 32.

Figure 32: shows an example of commands used to program orders

Quantity

There are a number of alternatives that can be used instead of defining the quantity as the number of shares:

SHARES   number of shares

CASH

amount of cash units

%CAPITAL   percentage of the current capital

%LIQUIDITY   percentage of the current available cash

Examples of these commands are given below in figure 33.

REM Buy 10000USD worth of stock

BUY 10000 Cash AT MARKET

REM Buy using 50% of the current capital when dow chemical is 30,50
current = 39,84

BUY 50 %Capital AT 30.50 LIMIT

REM Buy using 20% of available cash when dow chemical is 45.12

BUY 20 %Liquidity AT 45.12 STOP

REM all trades that exit like sell and exitshort you do not need to enter the
count

SELL AT MARKET

Figure 33: commands used to set quantities

Date of execution

If not instructed orders are executed on the next bar; however market orders can be executed before or after this bar using the following commands.

ThisBarOnClose   at the close of the current bar
NextBarOpen   at the open of the next bar **(default order)**
NextBarClose   at the close of the next bar

TodayOnClose   at the close of the current day
TomorrowOpen   at the open of the day after
TomorrowClose   at the close of the day after

An example can be seen in figure 34 below.

Figure 34: use of when to execute commands

Price Terms

These terms are technical analysis basics; used to emphasize certain aspects. For example when calculating a moving average it can be based on the open and close or a formula derived upon the high, low and close, as in figure 37, the weighted moving average is calculated on the closing price or periods to the prior 30days.

The terms that can be used with there definitions are:

Open	Opening price of the current bar
High	Highest price of the current bar
Low	Lowest price of the current bar
Close	Closing price of the current bar
OpenOfNextBar	Opening price of the next bar

Time Frames

You can also use other time frames for your program, see below for the list of functions and descriptions.

Minute	Minute of the close of the current bar
Hour	Hour of the close of the current bar
Day	Day of the close of the current bar
Month	Month of the close of the current bar
Year	Year of the close of the current bar
DayOfWeek	Day of Week of the close of the current bar (where Monday = 1, Tuesday = 2 etc.)

An example of the use of time frames is given in figure 38.

MIN/MAX

This mathematic function will return the lowest and the highest of two elements; you need to use the below convention. An example of its use is given in figure 50.

MIN (a, b)   where a and b are two defined conditions or quantities e.g.

MAX (a, b)   MAX(open, close)

Control Structures

A control structure can be created using the below commands, where you can extend or simplify the else/elsif conditions as you require, a simple example is given in figure 37.

IF *test1* **THEN**

                              Instructions 1

ELSIF *test2* **THEN**

                              Instructions 2

ELSE

                              Instructions 3

ENDIF

REM use of a simple control structure

IF close > WeightedAverage[30](close) THEN

    BUY 10000 Shares AT MARKET

End of the program →   ENDIF

Translation of program –

If the close is greater than the close of a 30 period weighted moving average

Then buy 10000 shares at market price

Figure 37: example of the use of a simple control structure

Lets look at another example. Many traders know through historical data that markets tend to rise around October till late April and then fall from May till September. Lets see what happens if we short UK100 in May and buy in October investing 60% of our capital, over five years. Figure 38 shows the program used in this example on the 5-year daily chart.

```
REM Sell short in May

IF Month = 5 THEN

        SELLSHORT 60 %Capital AT MARKET

REM Buy to close in October

ELSIF Month = 10 THEN

        Buy 60 %Capital AT MARKET

ENDIF
```

Translation of program –

If the month is May then go short 60% of the available capital at market price

Else if the month is October then buy 60% of the capital at market price

Figure 38: program used to sell short in May and go long in October

From figures 39 and 40 it can be seen that this is a good strategy.

CMC Markets

Detailed Report: UK100

Statistics | Orders list | Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	2832.11	1243.24	1588.88
Gross Profit	4036.67	1264.05	2772.62
Gross Loss	-1204.55	-20.81	-1183.74
Profit Factor	3.35	60.74	2.34
Total Number of Trades	11	5	6
Percent Profitable	63.64%	80.00%	50.00%
Winning Trades	7	4	3
Losing Trades	4	1	3
Even Trades	0	0	0
Avg Trade Net Profit	257.46	248.65	264.81
Avg Winning Trade	576.67	316.01	924.21
Avg Losing Trade	-301.14	-20.81	-394.58
Std Deviation of Trade Profit	548.69	179.06	724.65
Largest Winning Trade	1237.16	493.00	1237.16
Largest Losing Trade	-687.99	-20.81	-687.99
Avg Bars in Trades	120.00	151.60	93.67
Avg Bars Beetween Trades	8.50	21.25	17.00
Avg Bars in Winning Trades	120.00	151.50	78.00
Avg Bars in Losing Trades	120.00	152.00	109.33
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	93.95%	93.95%	93.95%
Total Commission	100.89	48.76	52.12
Max Consecutive Winning Trades	5	1	2
Max Consecutive Losing Trades	3	1	3
Max draw down	1458.18	896.00	1668.02
Max equity run up	3048.24	1431.82	2663.07
Return on initial capital	28.32%	12.43%	15.89%

Modify Backtest | Close

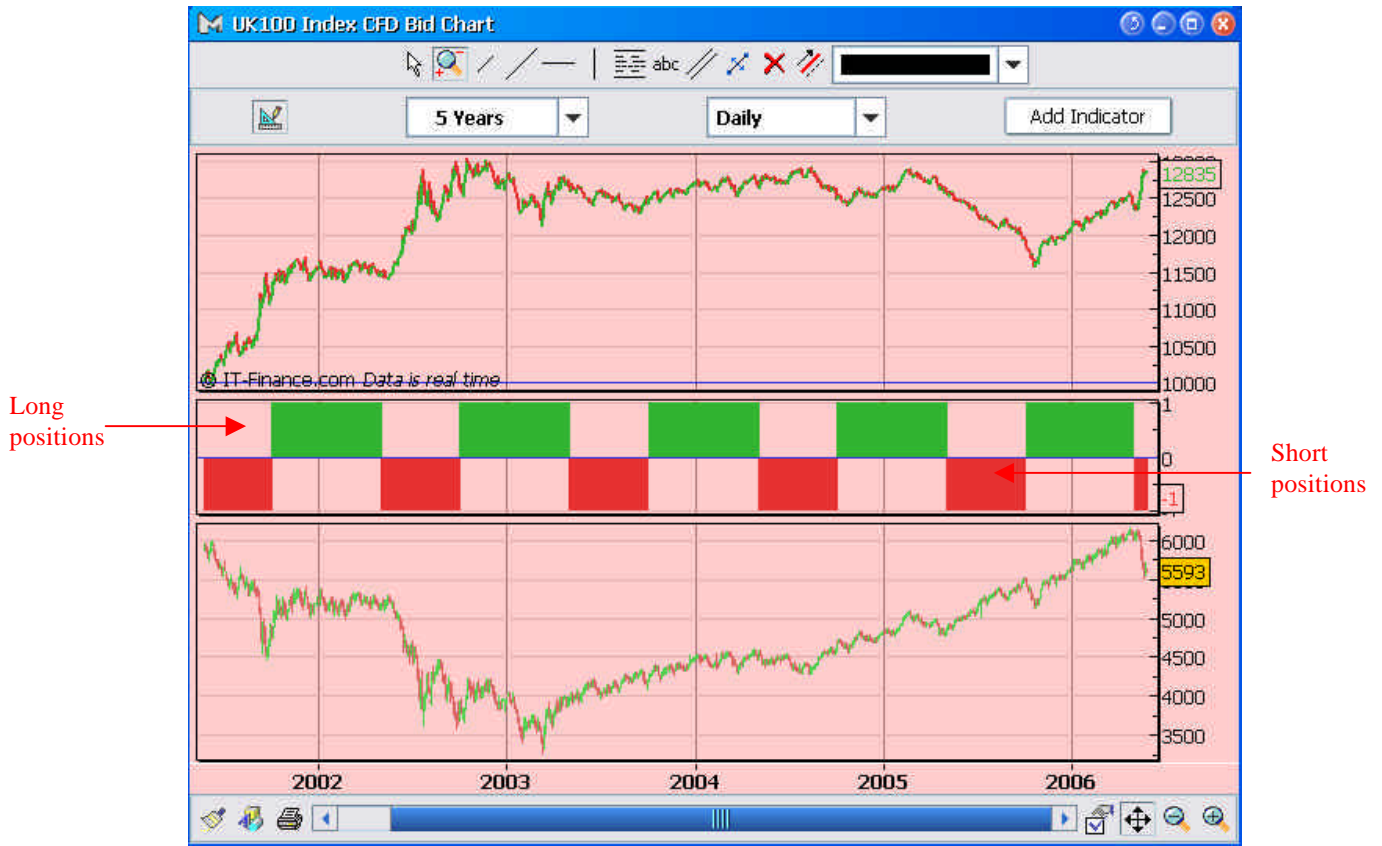Figure 39: Detailed statistics report showing a healthy 28% return

Figure 40: chart showing our backtest

Test yourself

Try and create a similar program yourself, on the same 5year/daily UK100 chart, so that we go long in month 10, sell out month 1, then go long again in month 2 and close out in month 5. We will invest 100% of our capital

Turn over and look at figure 40 if you struggle, figure 41 gives the results of this strategy.

REM go long in month 10 and sell in month 1 and then again in Month 2 sell in month 5

IF Month = 10 THEN

    BUY 100%capital AT MARKET

ELSIF Month = 1 THEN

    SELL AT MARKET

ENDIF

IF Month = 2 THEN

    BUY 100%capital AT MARKET

ELSIF Month = 5 THEN

    SELL AT MARKET

ENDIF

Translation of program –

If its Oct then buy 100% of our capital at market price, else if it's Jan then sell at market price

If it's Feb then buy 100% of our capital at market price, else if its May then sell at market price

Figure 40: program showing 2 longs from Oct to Jan and then Feb to May

	All Trades	Long Trades	Short Trades
Total Net Profit	2322.81	2322.81	0.00
Gross Profit	2865.12	2865.12	0.00
Gross Loss	-542.31	-542.31	0.00
Profit Factor	5.29	5.28	n/a
Total Number of Trades	11	11	0
Percent Profitable	72.73%	72.73%	n/a
Winning Trades	8	8	0
Losing Trades	3	3	0
Even Trades	0	0	0
Avg Trade Net Profit	211.16	211.16	n/a
Avg Winning Trade	358.14	358.14	n/a
Avg Losing Trade	-180.77	-180.77	n/a
Std Deviation of Trade Profit	290.74	290.74	n/a
Largest Winning Trade	700.08	700.08	0.00
Largest Losing Trade	-318.20	-318.20	0.00
Avg Bars in Trades	64.45	64.45	n/a
Avg Bars Beetween Trades	69.70	69.70	n/a
Avg Bars in Winning Trades	65.00	65.00	n/a
Avg Bars in Losing Trades	63.00	63.00	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	50.43%	50.43%	50.43%
Total Commission	203.19	203.19	0.00
Max Consecutive Winning Trades	5	5	0
Max Consecutive Losing Trades	1	1	0
Max draw down	1259.63	1259.63	0.00
Max equity run up	3547.07	3547.07	0.00
Return on initial capital	23.23%	23.23%	0.00%

Figure 41: detailed statistics for the backtest showing a good profitable strategy

Insert Function

As shown in figure 20 under the creation by programming tab there is a 'insert function' button. This brings up a window with all the available functions, which are categorized including the ones that you create, as seen below in figure 42. It also provides help with more information about a chosen function.
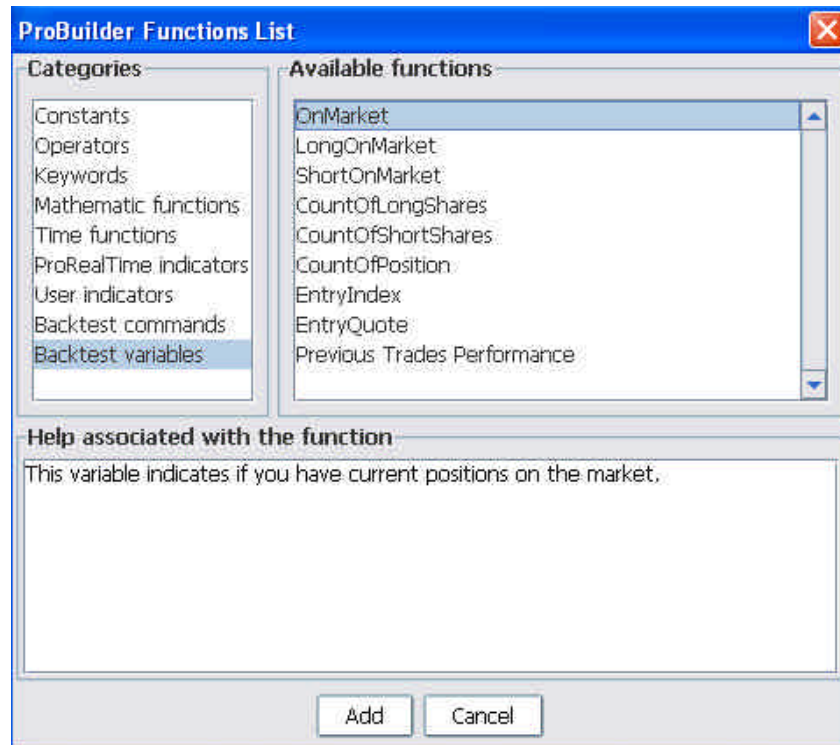
Figure 42: functions list available from the insert function button

State Variables

The three possible variables are: **OnMarket**, **LongOnMarket** and **ShortOnMarket** refer to being flat, long or short. Hence this function allows you to know the state of your backtest portfolio.

The importance of this is associated with knowing your position's direction. As the reasons why you want to execute orders will not always be the same. Different results are produced dependent on being long, short or flat. E.g. the exit of a long and an uncovered sell are two different strategies, hence the former is a position closed and the latter is being opened.

Examples on the use of this order are given in figures 43 and 44.

Logical Operators

The operators described below are used to implement combinations of comparisons.

NOT (a)   Logical NOT

a **OR** b   Logical OR

a **AND** b   Logical AND

a **XOR** b   Logical Exclusive OR

An example of the use of these functions is given in figures 43 and 44.

AS

Commands and variables are linked to one or more strategies. If you do not define your strategy, the backtest will create one strategy and all commands are then linked to it. There is no limit to the number of strategies you can create.

The keyword **AS** is used to classify several strategies within the same program. Hence you use this function so that the instructions only apply to this strategy. An example is provided below in figure 43.

Translation of program –

If the closing price is greater than moving average based on 50 period closing price and you have no positions then buy 50% of the available cash at market price for our strategy 'moving average'

If the closing price is less than the low calculated as the current bar minus the bar, which the latest order was

Figure 43: the use of the function AS in a backtest

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Variables of Position Following

These variables give more precise information on the state variables. They will tell you whether you have positions currently and if so how many.

The three variables are:

CountOfLongShares   the count of shares in a long position (0 if not long)

CountOfShortShares the count of shares in a short position (0 if not short)

CountOfPosition   the count of accumulated positions (if pyramid is allowed)

Figure 44 below shows an example of the use of variables. The program buys 10000 shares or quantity in this case on the EURUSD spot when the price breaks out from the 20day moving average. If the conditions are met then the program continues to buy up to 3 times and sells the position on a new low breakout.

```
REM buy when the price breaks out of the 20day moving average
condition1 = close > AVERAGE[20](close)

REM this condition is to enter the market
IF NOT OnMarket THEN
        IF condition1 THEN
                BUY 10000 Shares AT MARKET
        ENDIF
ENDIF

REM if the buy condition is true pyramid the position 3 times
IF OnMarket THEN
        REM condition 2 is given by a new low breakout
        condition2 = close < LOWEST [15](low[1])

        REM the exit depends on a double condition
        IF NOT condition1 or condition2 THEN
                SELL CountOfLongShares Shares AT MARKET

        REM pyramids 3 times while the exit condition is false
        ELSIF CountOfPosition < 3 THEN
                BUY 10000 Shares AT MARKET
        ENDIF
ENDIF
```

Translation of program –

Condition1 is the closing price has to be greater than the 20-day moving average based on closing price

If there are no positions then if condition1 is met buy 10000 at market price

If there is a position then condition2 is when the closing price is less than the lowest calculated moving low price of the indicator where we refer to 15bars on indicator1
Lowest [count bars](indicator)

If neither condition is being met then sell all the shares at market

Else if the position is less than 3 then buy 10000 at market price

Figure 44: use of variables example on EURUSD

The use of pyramids is only permitted if the option 'accumulate positions' is ticked in the capital management window as seen in figure 5 under the section positions management.

Also if you use 1 stop for all positions then all positions will be merged into one so the count cannot be greater than one.

Figures 45-48 show our results as not a profitable strategy.

Figure 45: shows the detailed report statistics

Figure 46: above is the orders list where the quantities can also be seen to be accumulating

Figure 47: the backtest trades list all the positions were long

Figure 48: the EURUSD chart showing our backtest results

Bars Access Relative to the Last Executed Order

There are two types of commands. **EntryIndex**, which is the index of the bar on which the latest order, was executed and **EntryQuote** gives the price of the last order.

Another commonly used command is **BarIndex**, which is the index of the current bar in the chart (from 0).

An example is provided below in figure 49.

REM buy on a moving average breakout

IF NOT OnMarket THEN

    IF close > ExponentialAverage[20](close) THEN

        BUY 10000 Shares AT MARKET

    ENDIF

ENDIF

REM exit under the lowest price of the candlestick ent

IF OnMarket THEN

    SELL AT low[BarIndex - EntryIndex] STOP

ENDIF

Translation of program –

If there are no positions then if the closing price is greater than the 20-day exponential moving average calculated based on the closing price then buy 10000 shares at market price

If there is an open position then, stop sell at the low given by the current bar minus the last order bar

You could use EntryQuote here, e.g. to exit under the market price SELL AT EntryQuote STOP

Figure 49: an example of the use of bar access relative to the last executed orders

Stop loss programming

You can add four different types of stops as seen in the assisted creation on pages 13 and 14.

The function **SET STOP** *price* allows you to create a customized stop. An example of this is shown in figure 50.

Translation of program –

If the closing price is greater the moving average based on the closing price of 20 days and you have no positions then buy 10000 shares at market price

REM a following STOP

IF close > AVERAGE[20] AND NOT OnMarket THEN
    BUY 10000 Shares AT MARKET

    REM calculate the difference between ideal price and real price
    Spread = openOfNextBar - low

    REM initialize the highest price since the market execution
    Up = openOfNextBar
ENDIF

You can create you own names to these as long as they are referenced the same throughout the program

REM updates the stop to let its distance to the hightest price constant

IF OnMarket THEN
    Up = MAX(Up, high)
    SET STOP (Up - Spread)
ENDIF

MAX returns the higher of two elements

Figure 50: showing an example program of a stop

Test Yourself

Lets end with a test, looking at a UK pharmaceutical stock Glaxo Smith Kline (GSK) daily chart for a year. We want to create a backtest by programming using the Average True Range (ATR) so that we buy or sellshort when there is a panic in the market.

ATR is simply a moving average of true range calculated over a number of days. True Range and Average True Range are common volatility measurements. The larger the True Range, the greater the volatility of the stock.

Conditions for long positions
We want to buy at market price investing all our capital when the closing price of GSK is greater than the previous days close + the AVT based on the closing price of 30days.

Conditions for short positions
We want to sellshort at market price investing a third of our capital when the closing price of GSK is less than the previous days close - the AVT based on the closing price of 30days.

Then optimize the program to find the optimum AVT value testing from 20-40days with increments of 1.

(Turn the page to view figures 51-61 for help and the results)

Note: We will always hold a position, as it will reverse itself. We are using only a third of our capital on shorts as with short positions the potential loss in unlimited.

REM strong increase in prices = panic buy hence buy when:

IF close > close[1] + AverageTrueRange[30](close) THEN

    BUY 100%Capital AT MARKET

ENDIF

REM strong decrease of prices = panic selling hence sell when:

IF close < close[1] - AverageTrueRange[30](close) THEN

    SELLSHORT 33%Capital AT MARKET

ENDIF

Translation of program –

If the close is greater than the previous days close + the AVT based on the 30day closing price then buy 100% of the capital at market price

If the close is less than

Figure 51: the code required to generate this program

	All Trades	Long Trades	Short Trades
Total Net Profit	-165.25	4247.25	-4412.50
Gross Profit	19876.00	19151.00	725.00
Gross Loss	-20041.25	-14903.75	-5137.50
Profit Factor	0.99	1.28	0.14
Total Number of Trades	12	6	6
Percent Profitable	25.00%	33.33%	16.67%
Winning Trades	3	2	1
Losing Trades	9	4	5
Even Trades	0	0	0
Avg Trade Net Profit	-13.77	707.88	-735.42
Avg Winning Trade	6625.33	9575.50	725.00
Avg Losing Trade	-2226.81	-3725.94	-1027.50
Std Deviation of Trade Profit	4964.02	6872.77	1003.21
Largest Winning Trade	14040.00	14040.00	725.00
Largest Losing Trade	-5865.00	-5865.00	-2528.50
Avg Bars in Trades	33.92	49.83	18.00
Avg Bars Beetween Trades	4.00	8.80	8.80
Avg Bars in Winning Trades	83.00	94.50	60.00
Avg Bars in Losing Trades	17.56	27.50	9.60
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	90.27%	90.27%	90.27%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	2	2	1
Max Consecutive Losing Trades	5	1	2
Max draw down	18588.50	14329.50	7513.50
Max equity run up	22610.50	23468.50	7752.50
Return on initial capital	-0.17%	4.25%	-4.41%

Figure 52: detailed statistics report showing a flat strategy

Figure 53: the orders list for this test

Figure 54: trades list including the direction

Only a third of the capital on shorts over the long positions →

Figure 55: chart showing the backtest

To create the optimisation, follow the instructions below:

- If you click on 'modify backtest' on the detailed report, it will take you back to programming of our backtest
- In the code change the AverageTrueRange[30] to AverageTrueRange[number] both for the buy and sellshort
- Under the optimization parameters section shown in figure 20. Click on add and fill in the fields like figure 56 below, so that we have a range for our ATR from 20 to 40 with increments of 1
- Click ok and then validate the program again. The results figures 57-61 are now produced

New Parameter

Name used in the program	number
Label displayed in the interface	number
Parameter restriction	> 0

Optimizing

Minimal Value	20
Maximal Value	40
Step	1

OK   Cancel

Figure 56: defining the optimisation parameters

Optimize Report

Net Profits ↑	Return on Capit	Max Draw Down	Nb Orders	% Winning Trad	Expectation	number
16729.25	+16.73%	10917.50	10	50.00%	104.87%	31
16729.25	+16.73%	10917.50	10	50.00%	104.87%	32
16729.25	+16.73%	10917.50	10	50.00%	104.87%	33
16729.25	+16.73%	10917.50	10	50.00%	104.87%	34
16729.25	+16.73%	10917.50	10	50.00%	104.87%	35
16729.25	+16.73%	10917.50	10	50.00%	104.87%	36
16729.25	+16.73%	10917.50	10	50.00%	104.87%	37
16729.25	+16.73%	10917.50	10	50.00%	104.87%	38
16729.25	+16.73%	10917.50	10	50.00%	104.87%	39
16729.25	+16.73%	10917.50	10	50.00%	104.87%	40
6477.75	+6.48%	19789.00	10	30.00%	25.68%	20
6477.75	+6.48%	19789.00	10	30.00%	25.68%	21
6477.75	+6.48%	19789.00	10	30.00%	25.68%	22
6477.75	+6.48%	19789.00	10	30.00%	25.68%	23
6477.75	+6.48%	19789.00	10	30.00%	25.68%	24
6477.75	+6.48%	19789.00	10	30.00%	25.68%	25
6477.75	+6.48%	19789.00	10	30.00%	25.68%	26
5371.50	+5.37%	19641.75	12	33.33%	20.13%	27
5371.50	+5.37%	19641.75	12	33.33%	20.13%	28
5371.50	+5.37%	19641.75	12	33.33%	20.13%	29
-213.25	-0.21%	18588.50	12	25.00%	-0.80%	30

Figure 57: optimisation report for AVT values 20-40 days shows 31 as best

CMC Markets

Detailed Report: GSK optimised

Orders list | Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	16645.25	17101.50	-456.25
Gross Profit	24705.75	22404.00	2301.75
Gross Loss	-8060.50	-5302.50	-2758.00
Profit Factor	3.07	4.23	0.83
Total Number of Trades	10	5	5
Percent Profitable	50.00%	60.00%	40.00%
Winning Trades	5	3	2
Losing Trades	5	2	3
Even Trades	0	0	0
Avg Trade Net Profit	1664.53	3420.30	-91.25
Avg Winning Trade	4941.15	7468.00	1150.88
Avg Losing Trade	-1612.10	-2651.25	-919.33
Std Deviation of Trade Profit	5043.17	6597.93	1081.22
Largest Winning Trade	15120.00	15120.00	1518.75
Largest Losing Trade	-3118.50	-3118.50	-1421.00
Avg Bars in Trades	40.70	58.80	22.60
Avg Bars Beetween Trades	4.89	11.00	11.00
Avg Bars in Winning Trades	57.20	66.33	43.50
Avg Bars in Losing Trades	24.20	47.50	8.67
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	90.27%	90.27%	90.27%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	3	3	1
Max Consecutive Losing Trades	2	0	1
Max draw down	10917.50	10056.50	6358.00
Max equity run up	29069.50	30018.50	8719.50
Return on initial capital	16.65%	17.10%	-0.46%

Modify Backtest | Close

Figure 58: the optimised detailed report statistics

Figure 59: optimised orders list based on ATR of 31 days

Figure 60: optimized trades list

Figure 61: optimised graphical representation

This strategy from being barely breakeven has been turned around using the optimisation of the indicator by 16% excluding gearing. This goes to show how valuable or powerful backtesting can be.